RISER-TENSIONING DEVICE BALANCED BY HORIZONTAL FORCE

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This invention relates to a riser-tensioning device balanced by horizontal force. More exactly, a device based on wires for suspending and compensating a riser is concerned, in which the wire layout has been arranged in such a way that in the horizontal plane approximately equal wire forces, working in opposite directions, are applied to the horizontally movable pulley wheel slide of the tensioning device.

In the drilling of a well and in well maintenance work in connection with the recovery of petroleum offshore, it is common for the shutdown valve of a well, located on the seabed, to be connected to a vessel by means of a riser. At its upper portion the riser is provided with a telescopic element in order to absorb the heave motion of the vessel. The relatively great slenderness of the riser makes it necessary for the riser to be kept tensioned, while at the same time the heave motion of the vessel must be compensated.

A riser-tensioning device according to the prior art typically comprises at least one so-called jigger winch, in which a

wire is tightened by means of a hydraulic cylinder. Jigger winches may have a transmission ratio being such that the longitudinal movement of the wire is increased by a number of times relative to the displacement of the piston rod of the hydraulic cylinder.

From the jigger winch the wire possibly extends via one or more intermediate pulley wheels on to a pulley wheel placed in the vicinity of the riser and normally immediately below the drilling floor of the vessel. From the pulley wheel the wire extends down to a mounting collar at the upper stationary portion of the riser.

The hydraulic cylinder of the jigger winch is connected to an accumulator, so that the piston rod of the jigger winch can be displaced by an essentially constant force during the heave motion of the vessel, whereby the tensioning of the riser is maintained during the movement of the telescopic part in the riser.

On vessels which are provided with more than one drilling centre, it is necessary to be able to move the riser horizontally from one position to another. Due to difficulties in maintaining the tightening of the wire as the pulley wheels are being moved, the riser-tensioning device described above is not very suitable for use on a vessel of this kind. It is known to provide a vessel with an additional separate riser-tensioning device, which is arranged to be used in, for example, an auxiliary drilling centre.

Riser-tensioning devices are relatively large and occupy much space. With its wires and wire pulleys, an extra riser-

tensioning device occupies a considerable portion of the space available and adds to the weight of the vessel.

The object of the invention is to remedy the drawbacks of the prior art.

The object is realized according to the invention through the features defined in the description below and in the following claims.

The riser-tensioning device is provided with a running wheel which is placed on the opposite side of the riser relative to the normal horizontal tightening direction of the wire out from the corresponding pulley wheel. From the attachment of its one end portion at the mounting collar of the riser, the wire extends up to and over a first pulley wheel. Further the wire extends in an essentially horizontal direction to and over the running wheel, from which the wire extends through a jigger winch in accordance with a technique known as *per se*, and further in a substantially horizontal direction to and over a second pulley wheel and further down to the mounting collar, at which the second end portion of the wire is also secured.

Due to the wire extending from the first and the second pulley wheels in opposite directions and with equal tension, the resulting horizontal forces at the pulley wheels are balanced out.

According to the invention, the pulley wheel is supported in a pulley wheel guide movably connected to the structure of the vessel, preferably immediately below the drilling floor.

When the pulley wheel guide is moved, for example by means of a hydraulic cylinder, from one position to another position relativ to the vessel, the tensioning and the heave compensation of the riser-tensioning device are maintained during the movement of the pulley wheel guide, the wire equalizing the relative change in length of the parts of the wire by moving over the wire pulleys of the jigger winch.

It is obvious that due to constructional, maintenance and safety reasons more than one wire with associated pulleys and jigger winches must be used.

Through a device according to the invention, the resulting horizontal forces at the pulley wheels are reduced, whereby for example locking of the pulley wheel guide in the horizontal direction can be simplified to a considerable extent.

A non-limiting example of a preferred embodiment will be described in the following with reference to the appended drawings, in which:

Figure 1 shows a vertical section through a part of a vessel provided with a main drilling centre and an auxiliary drilling centre, and a riser being present in the main drilling centre;

Figure 2 shows the same as Figure 1, but here the riser is in the auxiliary drilling centre; and

Figure 3 shows a principle drawing of a riser-tensioning device.

In the drawings the reference numeral 1 denotes a vessel provided with a drilling floor 2, in which a main drilling centre 4 and an auxiliary drilling centre 6 are arranged.

A riser 8 extends up through the moonpool 10 of the vessel, and is at its upper portion provided with a mounting collar 12 and connected to a telescopic element 14, the telescopic element 14 being connected to the vessel 1 and arranged to be moved sealingly within the riser 8 during the heave motion of the vessel 1.

A pulley wheel guide 16 comprising a number of pulley wheels 18' and 18" is connected in a horizontally movable manner to the underside of the drilling floor 2 by means of slides 20.

A number of wire-tensioning devices in the form of jigger winches 22 are placed in connection to the relatively strong structure of the drilling floor 2. Each jigger winch 22 comprises, in addition to a hydraulic cylinder 24, at least a winch pulley 26, a number of intermediate pulley wheels 28', 28" and a wire 30.

The first end portion 32 and the second end portion 34 of the wire 30 are both connected, preferably diametrically opposite each other, to the mounting collar 12 of the riser 8. From its first end portion 32 the wire 30 extends up to and over the first pulley wheel 18', see Figure 3, further essentially in a horizontal direction parallel to the direction of movement of the pulley wheel guide 16 to and over a running wheel 36, the running wheel 36 being secured to the structure of the drilling floor 2.

From the running wheel 36 the wire extends from a first intermediate pulley wheel 28' over the winch pulley 26 and further over a second intermediate pulley wheel 28" and further in an essentially horizontal direction parallel to the dir c-tion of movement of the pulley wheel guide 16 on to and over the second pulley wheel 18" and further down to the mounting collar 12.

When pressurized fluid is supplied to the hydraulic cylinder 24 of the jigger winch 22 from an accumulator, not shown, the piston rod 38 of the hydraulic cylinder 24 moves the winch pulley 26 so that the wire is tightened, thereby causing a tensile force to be assigned to the riser.

The tensile forces from the two horizontal parts of the wire 30 acting on the first pulley wheel 18' and the second pulley wheel 18", respectively, balance out and thus do not exert any resulting horizontal force on the pulley wheel guide 16. Thus, a locking mechanism, not shown, for the pulley wheel guide 16 relative to the drilling floor 2 may have a relatively slim design.

When the pulley wheel guide 16 is to be displaced along the slides 20 in order to move the riser from the main drilling centre 4 to the auxiliary drilling centre 6, the distance from the first pulley wheel 18' to the running wheel 36 is shortened, while at the same time the distance from the second intermediate pulley wheel 28" to the second pulley wheel 18" is lengthened correspondingly. These changes in length are equalized by moving the wire across the intermediate pulley wheels 28', 28" and winch pulley 26 without neither the tensile force applied to the riser nor the heave compensation being disturbed.

If desired, one end portion, 32 or 34, of the wire may be connected directly to the pulley wheel guide 16.

The invention is suitable for use also on board a vessel with no displaceable pulley wheel guide 16, but full use of the advantages of the invention cannot be made in such a solution.

Relative to the prior art, the device according to the invention allows a considerable improvement and simplification of the riser-tensioning device of a vessel 1.